Chelmsford Amateur Radio Society

Club Station Call Sign GØMWT

Issue Number 338 March 1994

NEXT MEETING - Radio Communications within Anglian Water

Last April we enjoyed an interesting lecture on the distribution of water to our homes; to continue this information we will now learn about the complex control systems behind the network.

This month our guest speaker is Alan Sargeant, who will describe the communication systems that monitor and control water in our very variable and unpredictable environment.

The meeting will open at 7.30pm on Tuesday 1st March, in the Marconi College, Arbour Lane, Chelmsford, we are sure that this will be an informative lecture for all members.

DATES FOR YOUR DIARY

1 Mar. CLUB MEETING - Anglian Water Communications.
12/13 Mar. RSGB LONDON RALLY - Picketts Lock.
13 Mar. RADIO SIGNAL TRIALS - for the Tiptree site.
5 Apr. CLUB MEETING - 'The Tidal War' - Stan Wood.

ANOTHER VISIT TO STANSTED - Brian, G3CVI

Plans for a second group of club members to visit the inner workings of Stansted Airport are in hand.

Brian has a list of names from the overflow of the first visit but he would like to confirm that these members still wish to join the limited party. Please check with Brian either at the meeting or by telephone.

RSGB Geo-Physical Broadcast - GAM1

Gwyn, G4FKH, Project Manager for the proposed GAM1 Beacon is seeking technical back-up. The ideal volunteer will be local and from a professional radio background. If you are interested, please write to Gwyn (he is not easy to get on the telephone).

MEMBERS NEWS - Ela, G6HKM

This month we are pleased to welcome John Goldsmith, G4KTX, it was nice to hear you on the Club 10 metre net John.

BACKNANG - CHELMSFORD RADIO LINK

A request was made to Tom, G4INM by the Twinning Society for information to be printed in the Twinning Newsletter, regarding the radio link with our twin town in Germany. Tom replied:-

"The Chelmsford Amateur Radio Society and The Backnang Amateur Radio Society hold weekly radio 'nets'. Amateurs from both societies meet weekly over the air and discuss daily happenings and general topics. This has become a regular practice. On Sunday evenings at 10.30pm C.E.S.T. (Summer Time) or 9.30pm B.S.T., Roy in Chelmsford and Peter in Backnang establish contact. After they have started the net, various other amateurs, call in. There is also a net on Tuesdays at 1.00pm B.S.T. It is all very friendly and has helped to cement relationships between both towns.

Peter and most other German Amateurs speak faultless English. This means the net is conducted in English and I do not get much chance to practice my German. English is the universal language on the air. Most radio amateurs learn enough English to carry on a short conversation. Radio has helped members of both clubs to a greater understanding of each others way of life".

BOOK PURCHASES FROM RSGB

Colin Lodge, G4IIK will be calling at the RSGB Headquarters soon and has kindly offered to collect books, etc., for memebers. If you would like to take up Colin's offer please see him at the next meeting with your order and cash.

COMMITTEE MEETING

The next Committee meeting will be held on Wednesday 9th March at 7.30pm, in Telford Lodge; you are welcome to join us.

LAST MONTHS MEETING

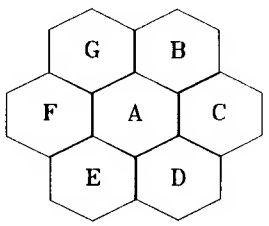
Report by Colin, G0TRM

Colin, G4IIK began his talk by discussing briefly the three main providers of mobile phone networks. The first, CELLNET is a nationwide organisation has approaching a million subscribers. The second, MERCURY ONE-ONE service operates generally within the bounds of the M25 ring road together with a few other main traffic routes and uses a frequency of 1.8GHz. The third, VODAFONE is again a nationwide network with currently many more subscribers than CELLNET, something over a million, however it is accepted that the ratio of customers varies from time to time. With the total number of subscribers continuing to rise, so will the number of calls per month, these being in the region of 50 million.

Not surprisingly Colin chose to talk mainly about the VODAFONE organisation, as he is employed by them as a maintenance engineer. He is based at Dartford where the exchange for this area is situated, it covers an area from Godstone to Hertford and up to Sudbury. The Headquarters are situated at Newbury with some 1000 staff occupying 24 buildings in the area. Overall, approximately 1400 people are employed throughout the country.

In any telephone system three main aims need to be satisfied:-

a) the need to provide efficient, reliable, high quality low cost communications, b) the system must have the capacity to meet increased user demand and c) the need to provide 24 hour coverage. Cellular telephone systems have the overall title of TACS or ETACS which stands for Extended Total Access Communication System.



As the name cellular implies, the coverage area of a system is split into a number of cells, initially 3, together forming a larger cell, and seven of these larger cells forming a cell cluster. Seven different sets of frequencies are allocated to the seven cells forming the cluster. The cells are hexagonal in shape and arranged geographically in a circular manner around a centre cell so that like frequencies are always three cells apart when several clusters are arranged side by side. The frequency range used by VODAFONE is 870 - 960MHz, providing 1000 duplex channels with 25kHz spacing. In all cases the lower frequencies are allocated to the mobiles and the higher frequencies allocated to the base stations, with the paired frequencies being 45MHz apart. Frequencies within this range are also used by CELLNET. Apart from the rules laid down by the DTI, careful control is kept on the output power of both base stations and the mobiles in order to keep co-channel interference down to minimum. Some interference does occur on the air but not on the lines to the exchange, as these are all digital circuits.

Of the 1000 channels available 21 are used as control channels, one of these is the Forward Control Channel, FOCC and one the Reverse Control Channel RECC, they carry the majority of the control functions required.

One channel in each cell looks for Mobile action such as 'start call' and 'end call' etc. (continued on Page 2)

FIELD DAY SURVEY

On Sunday 13th March at 10am, Gwyn, G4FKH and Brian, G0BDS will operate a test station on the proposed new site at Tiptree.

The tests will comprise of listening on CW portions the HF Bands and exchanging comparative reports on 2 metres FM with club members at their home stations. Details will be announced at the March meeting.

LAST MONTHS MEETING - continued

When a Mobile is first switched on it sends out a stream of data which is analysed by the nearest base station indicating its geographical position. From then on the Mobile automatically Transmits at timed intervals enabling the base station to keep a check on its movements from cell to cell.

When a call is initiated the Mobile scans the control channels and picks the one with the strongest signal and locks on, it then sends its ESN, electronic serial number to the base station where it is checked and verified. All information on the control channels is sent at 8kbits/sec. Once the Mobile is accepted, a voice channel then takes over from the control channel and the call can commence using standard telephone procedures, once the lines between base station and exchange have been checked out satisfactorily. Throughout the call and at other times constant monitoring of the channels takes place to ensure their quality. This is done using the SAT, supervisory audio tone, a 6kHz signal which is used to check the signal to noise ratio of the link, if it falls below a certain level then another voice channel is chosen on which to continue the call. During the actual call all control of the channel, such as power output, handoff, frequency changing etc is done using the voice channel and the control channel is not used. At end of a call the control channel takes over again. The RF output power from the Mobile is changed automatically to ensure only sufficient power is used for the call and no more. There are 7 power levels available, ranging from 5mW to 7 watts.

Each base station consists of a Receiver, a Transmitter and a control unit, with the control unit carrying out a large range of operations at high speed.

A scanning receiver at the base station scans the channels of all the adjacent cells looking for any mobile that maybe transmitting, it can scan 600 channels in a few milliseconds. If the signal level is below a certain limit a 'handoff' signal is sent to the exchange. The exchange receives data from all the cells and selects the best received signal and switches to the base station with the best signal to noise ratio.

The system then changes the voice link to the new station along with the SAT signals and a new frequency is selected in the Mobile and the call continues without interruption. When a Mobile terminates a call, a 'call release' message is sent to the exchange, the voice transmitter turns off and the control channel then starts up again.

If a call is made to a Mobile that is switched off, incorrect data is received on the RECC and in turn a voice recording is played to the person initiating the call telling them of the situation. A small charge is made to the caller even though no contact was made, there is a way to overcome this however, (but only if you know). If a link fails for any reason a hang time of some 5 seconds is used before the link is broken, this to allow for the conditions to improve. In order to ensure the best possible links, diversity reception is used at the base stations. In some cases to overcome the problem of difficult receiving black spots, known colloquially as VODAHOLES (Chairmans Choice) a series of low power mini-base stations have been established carrying a limited number of channels to act as repeaters.

VODAFONE started as an analogue system but more and more digital techniques are taking over, and the two systems will continue to run side by side. Digital systems are very, very much faster than analogue ones and whereas channels are used now, digital systems use time slots. As example slot 16 is used to find the whereabouts of the Mobile. The links from the base stations to the exchanges use 2 Megabit signals using TDMA. The 2048K/ bit gives 32 x 64bit slots, 30 of which are used for subscribers and two for control purposes on each link. Some of these links use high grade BT lines and others use 11 - 12GHz PCM radio links. Colin indicated that generally the system was very reliable and faults were due mainly to handset and user problems. He showed us his two most used maintenance tools, a small screwdriver and a laptop computer. It is with the laptop that Colin is able to interrogate most if not all parts of the system using his portable phone and a modem. In this way when a fault is reported, he can diagnose the problem and often find the solution, before setting out on a journey.

The cost of making calls was discussed briefly, and the different tariffs involved. One point did emerge suggested that at certain times of the day it would be cheaper to phone Scotland say, using Mobile phones that it would be to use the BT network.

After a very detailed and informative evening, Colin concluded his talk by giving us a demonstration by setting up a link between a digital phone and an analogue one, with the call going all the way to Dartford and back again. It seemed almost as the last digit was dialled the second phone rang.

Our thanks to Colin for all the work involved in preparing his talk and also to Roy, whom Colin would like to thank for his work concerned with the production of the slides.

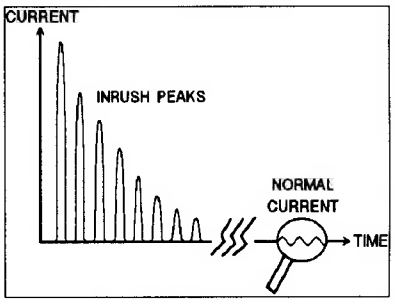
We look forward to Colin's second talk sometime in the future, in which he will concentrate on the digital side of the operation.

INRUSH EXPLAINED (Part Two) - Ken, G3PMW

Inrush current protection of iron cored components is quite a different matter to the simple resistive case of a light bulb or a valve filament. It is not obvious where inrush current comes from in a mains transformer, in motors it is, they will take excessive current while stationary, not reducing until up to full speed.

Ignore the first reaction that our transformers are normally connected to rectifiers with a large capacitor load, we must consider the case of a mains transformer with a constant high resistance load, or even better an unloaded mains transformer. One's first thought is that, as an iron cored device, the inductance is enormous (hundreds of henrys) and so the current taken from the mains will be very small. This is correct as far as the normal running current is concerned but not at switch on. The strange fact about transformer switch on current is that it depends mainly upon the exact time it was last switched off, i.e. the part of the mains cycle when current ceased to flow. This means that the iron core is left magnetised, and it is not possible to predict by how much. Occasionally, it will be left at the peak of the magnetising cycle and is therefore very close to saturation.

A saturated iron core does nothing for the inductance, and in this condition is virtually the air-cored inductance of the primary winding, very small, probably millihenrys. Applying A.C. will demagnetise the core, but not for quite a few cycles, consequently, we have some very high current peaks until the core is normal. (See Figure which is a simplified oscilloscope picture). How quickly, will also depend upon the part of the mains cycle at switch on. This description is considerably simplified, but it serves to show what happens.



The transformer designer can, and does, control the magnitude of these current peaks. He can run the iron in a less saturated state or make the air-cored inductance larger, but both make the transformer bigger and more expensive. They will also alter the leakage reactance and the winding resistance. The balance of these two can be crucial to the required operating conditions, which drives the cost up even more. Extra winding resistance means 'loss' and 'heat', both undesirable. With baby mains transformers all of these considerations are irrelevant, but it is surprising how soon they begin to count. To quote a personal experience in which I designed a 1KW Power Unit for a 400 watt Linear Amplifier, the running current was 4 amps but the first inrush peak was 92 amps! The transformer was a 6 inch cube, quite typical of the modern "black box".

Protection is a problem. Slow-blow fuses or a delayed MCB can be used, but the better solution is to use a high wattage series resistor at the mains input, which is shorted out by a relay after a short time interval. Many designs use this technique, it has the advantage that it also controls the rectifier/capacitor charging current.

Transformers are not easy to protect. Commercially, they are designed for their specific application and only one function, i.e. no filament windings on an HT transformer, they would be separate transformers. The reason is that multi-winding transformers have too much leakage loss for one winding alone to activate the fault protection. How many transformers can you think of that burned before the fuse blew?

Addendum. In Geoff's technical tip of last month, in which he advocates the use of diodes to give loss-less mains drop, it does not take much imagination (from the above description) to realise why his transformer burned out. The diodes maintained the magnetic saturation of the core, and the heavy inrush current was maintained until the inevitable happened.

Many thanks for the interesting technical articles. More next month, please keep them coming folks, Editor.

73 from Roy & Ela Martyr,
G3PMX & G6HKM

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